

Communicating Sustainable Design

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Abstract

This paper outlines research undertaken at Loughborough University to investigate innovative methods of communicating the complex issues associated with Sustainability with post-16 students in the UK as part of their design and technology education. A series of posters articulating elements of sustainable design were developed by a team consisting of; sustainable design experts, two industrial designers and an undergraduate design student. The poster designs were presented to post-16 students and teachers in three iterative development cycles with the responses recorded using a mix of semi-structured discussion and a series of questionnaires. The research results indicate that posters can provide a useful and innovative method of communicating sustainable design issues to students in Design and Technology. However, the results also show that the content of posters must provide a balance of inspirational images and detailed information, with further resources available to enable more in-depth study. These findings are now being used to produce a final poster set which will be published by ITDG in the coming year and available for use by students when tackling sustainable design.

Keywords

Sustainable design, education, graphical communication, posters

Introduction

Sustainable design as a subject has developed considerably over the last ten years with the increase in awareness of environmental and social issues in industry (Von Weiszacker et. al, 1997; Hawken, 1993; Wackernagel & Rees, 1996). This awareness has been driven by two factors, the increase in world wide legislation relating to the environmental performance of industry and the increasing concern from the public about environmental and social problems (Sarkis 2001). At the same time it has been recognised that sustainability must also be introduced into the curriculum at both further and higher education levels to ensure that the workforce of the future have a good

understanding of their responsibilities (Ali Khan, 1995; Sterling, 2001).

Education for sustainable development enables people to develop the knowledge, values and skills to participate in decisions about the way we do things individually and collectively, both locally and globally, that will improve the quality of life now without damaging the planet for the future.
(Department for Environment Rural Affairs and Food, DEFRA, 1998)

Design is just one area of the curriculum that is beginning to benefit from this change in focus and where many new initiatives are beginning.

This paper outlines research that has been undertaken at Loughborough University to investigate innovative methods of communicating the complex issues associated with sustainability with post-16 students in the UK as part of their design and technology education. The research was conducted as part of the Sustainable Design Award (SDA) run by the Intermediate Technology Development Group (ITDG). The SDA is a scheme integrated into normal design and technology coursework for students in the post -16 age group. The scheme aims to help students explore environmental, economic, social and moral issues in Design and Technology and has been undertaken by students in over 300 schools in England and Wales. (Capewell & Norman, 2003)

Literature review

The following section presents a brief review of the existing research literature, concerning communicating sustainability within design and teaching the key issues for successful education in sustainable design

Communicating Sustainability within Design

The process of sustainable development requires us all to think differently about what we do, how we do it and why we do what we do. While this may sound a straightforward enough task, there's plenty of evidence emerging- climate change, loss of biodiversity and increasing social dislocation - to suggest otherwise (Huesemann,

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2003). Consequently there are many different and often complex issues to get to grips with in order to begin to understand sustainable development and, in particular, a designer's role in making a difference in the future.

Previous research has indicated that this complexity has led to confusion amongst professional and student designers about their ability to effectively take part in sustainable design activities (Sherwin, 2000; Lofthouse, 2001). Many designers feel that sustainability is a subject which requires very detailed technical knowledge and therefore makes it difficult for them to understand and apply it in their everyday design work (Lofthouse & Bhamra, 2001).

Research has focussed on how to communicate the complex information required by designers to enable them to begin to consider sustainable design and this has examined and developed tools to be used as part of the design process (Lofthouse & Bhamra, 2001). However to date the research has not considered how this can be applied to post-16 students and enable them to engage with sustainability when designing. This issue of communication became particularly important to the organisers of the Sustainable Design Award as they were trying to educate students about sustainability through design activity rather than through written exercises.

Technology has a tradition of visual representation since the Renaissance of the 15th Century (Ferguson, 1977). The visual system is considered by both Damasio (1994) and Kosslyn (1994) to be the main way in which stimuli reach the brain. Riding and Rayner (1998) found that individuals fall into two categories when perceiving information; verbalists and imagers. There is some evidence to support designers as imagers, preferring graphical forms of communication to text or verbal methods (Storer & McDonagh, 2004).

This work attempts to derive the optimum format for presenting sustainable design tools, techniques and information to the students, through iterative development cycles. Various presentation media were considered, including; online resources, posters and booklets. However,

posters were considered to provide a useful starting point for a number of reasons. Posters may always be visible to the students throughout the Design and Technology classes, whereas, it may be difficult for a whole class to access online resources simultaneously. Posters would require very little expenditure from the schools to implement, and prototype designs could be produced and modified quickly and inexpensively, at the small numbers required for initial testing. The relatively short development time required for posters, would allow a wide range of iterations to be produced, and comprehensive feedback collected over a one year period

Key Issues for Successful Education for Sustainable Design

Previous research (Orr, 1994; Dewberry & Bhamra, 2005, DEFRA 1998) has indicated the range of subjects that students need to be introduced to in order to be able to consider issues of sustainability in their designing. Some of these subjects include:

- Key concepts of sustainable development
- Industry and sustainability
- Sustainable design
- Methods and tools for sustainable design

This has led to the development of modules and courses at both undergraduate and postgraduate levels within UK Universities. This work was used to help ITDG develop the programme of activities and information to support the students undertaking the sustainable design award and therefore became the basis of the content for the posters, as well as contributing to their teacher information pack and student website.

This range of subjects within sustainable design was used as the basis for identifying the key issues to be communicated to the AS and A2 level students and formed the starting point for the poster development research described in this paper. AS level study is undertaken by post-16 students for one year after GCSE examinations. AS consists of three modules that equate to half of an A level qualification. The students can continue with the subject for a further year and

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undertake and A2 level examination. However not all students continue to A2 level.

Research Method

In order to establish a poster series for communicating Sustainable Design it was first decided to recruit a team of two professional industrial designers who would work alongside lecturers and research students to develop the posters. These designers had limited previous experience of sustainable design and came to the subject with no preconceptions of what the posters would be communicating.

Throughout the research a series of questionnaires were used to gather data from students and teachers. These questionnaires were designed by the researchers in collaboration with the designers and sustainable design experts and then applied at the different research stages

The first stage was to provide the designers with an outline of some of the key issues in sustainability using the previous experience of one of the authors. It was decided that a one day workshop would be held for the designers where the key issues would be outlined and some methods and tools would be introduced and applied. After the one day workshop a team made up of two professional designers, two lecturers in sustainable design and design research students brainstormed poster content ideas over a one hour period. Following the brainstorming session three sustainable design messages were chosen. These embryonic ideas were developed by the Industrial Designers into three separate poster designs.

Figure 1 below outlines the stages of the research.

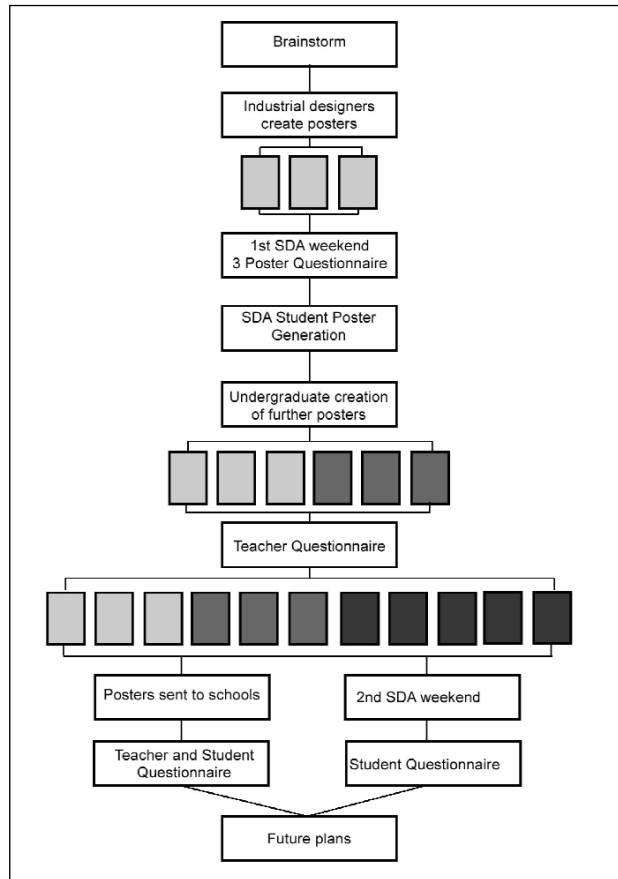


Fig. 1 Research process

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The draft posters were tested at a Study Weekend held by ITDG for the Sustainable Design Award attended by 70 AS and A2 students and 20 teachers in September 2003. The posters were shown to students who were required to complete a questionnaire about both their style and content, indicating areas they found particularly useful or confusing. After reviewing the three posters the students were asked to brainstorm some poster ideas. This was mainly to help them review the Sustainable Design presentations given by experts over the weekend and also to create a cognitive bridge to the next stage of the study weekend involving concept sketching and idea creation.

Following this event the feedback was used by an undergraduate design student to develop three further posters. These six posters were then shown to teachers at schools in the UK to gain feedback. The posters and their role in supporting sustainable design were presented by the researcher and semi-structured discussions followed on the merits of the poster designs. The researcher aimed to aid discussion rather than lead it. The teachers then critically reviewed the posters, and completed a questionnaire.

Five additional posters were created embodying the findings from the previous two surveys. The five new posters explored ways of presenting further sustainability issues using a similar graphical style to the earlier posters considered from the research to be successful. These eleven posters were taken to a number of schools in the UK and shown to 24 teachers and 56 students and also tested at a further SDA Study Weekend in September 2004 attended by a similar number of students and teachers. At the study weekend the posters were introduced by the researcher to a group of 24 teachers. At the same time student volunteers showed the posters to over 60 students who were free to observe and discuss the poster design and content in groups. As a result of these two sets of activities, questionnaires on these additional posters were completed by a total of 116 students and 48 teachers and the results analysed.

Poster Design

As outlined above three draft posters were initially developed from a brainstorming and a design session involving two professional industrial designers. The designers felt that it was important to not only communicate some key messages about sustainability but also to illustrate some sustainable design work, and sketching/presentation techniques.

The first poster in the series (Figure 2) illustrates the results of a previous research exercise where a professional industrial designer spent one hour 'brainstorming' design ideas for a bread toaster based on sustainable principles. Ten different concepts were sketched and the more successful collated, shaded and displayed on the poster. The poster presented a professional level of concept sketching and demonstrated what can be achieved during a very short design exercise and also highlighted sustainable design features.

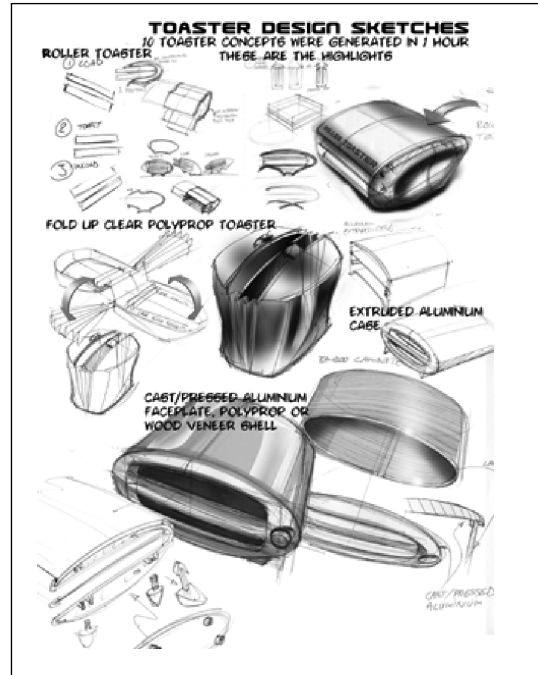


Fig. 2 Poster 1

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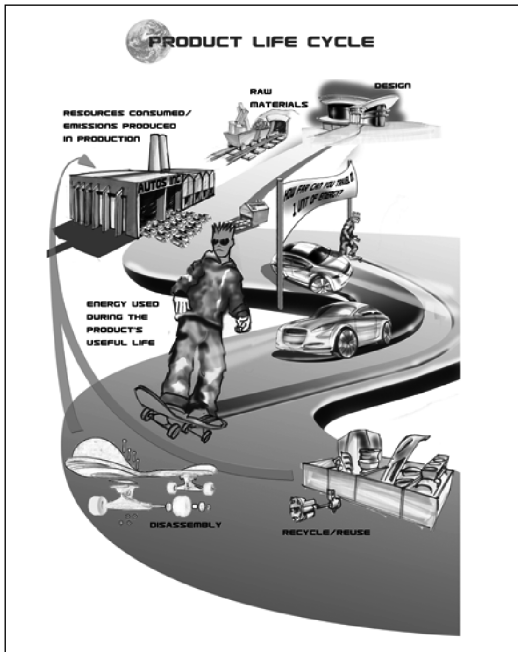


Fig. 3 Poster 2

Poster 2 (Figure 3) presents the same designer's description of a very simplified view of the life-cycle of two products. The illustrations represent:

- Raw materials and design ideas are fed into two factories, one producing cars and the other skateboards.
- The distance travelled by each mode of transport on the same quantity of energy/resource is indicated by the red trail left by the car and the green trail left by the skateboard.
- The two products are recycled and the component materials fed back into the factory.

The second industrial designer produced poster 3 (Figure 4) to communicate the effect purchasing decisions have on the world's resources.

The Global (or Ecological) Footprint analogy is used by many organisations (including the World Wildlife Fund and United Nations) to illustrate how much land and water area a human requires to produce the resources it consumes and absorb the waste it produces.

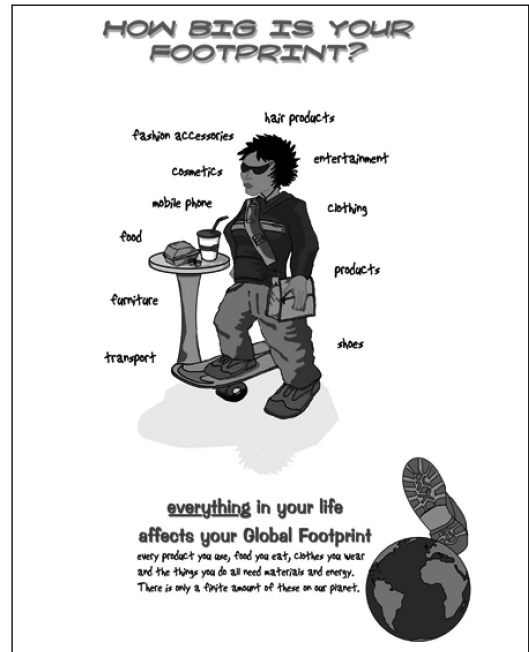


Fig. 4 Poster 3

Every action (including purchasing decisions) has a direct impact on the planet's ecosystems. This has little consequence as long as the use of resources does not exceed what the planet can renew. To relate this idea to the target audience of 16 to 18 year olds a character was drawn showing typical purchase and lifestyle decisions made by this age group based on the designer's observations. These ranged from transport, food and clothing purchases, through to beauty products, including hair gel and makeup and entertainment products such as MP3 players. The intention was that the students would be able to relate to the character and realise that each of their own purchasing decisions affected the size of their own global footprint. The final strap line explains the Footprint analogy in simple terms regarding the finite amount of resources available on the planet rather than an in depth discussion of how the footprint calculations can be completed.

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Initial Research Findings

As outlined previously the three posters were presented to students at the SDA study weekend. Towards the end of the weekend a poster questionnaire was used to assess the students' reactions to the posters asking them if they could remember what was included in the posters, what they thought should be included and whether any of the posters had helped to guide them in their thoughts and future designing. The students were also asked which poster they preferred and why, and what other posters they would have liked to see.

Of the three posters presented 42% of the students preferred Poster 1 (Sustainable Toaster Design), with 32% preferring Poster 2 (Product Life Cycle) and 25% preferring Poster 3 (Global Footprint). This result is a good indication of the preferred poster content revealed by subsequent questionnaires. In particular, the students were asked about how they thought the posters would help with their design work, their responses included the following:

- Style, enable better sketching and more free and easy flowing ideas
- Provide inspiration
- Explain sustainability
- Help with presentation techniques
- Creation of ideas/ variation
- Quicker idea generation from looking at pictures and existing products

In response to the question 'What else would you like to see examples of?' the students recommended the following:

- Disassembly / exploded drawings
- Drawings – more sketches
- CAD designs
- Annotations on sketches and pictures
- Presentation drawings
- Project work
- Other products explored or shown
 - Cars
 - CD covers/ cases
 - Tables - coffee/ dining
 - Street furniture
 - Garden Furniture
 - Mobile phones

The responses to both of these questions show that students are inspired by a professional designer's sketch work particularly in relation to real products or design projects. They are keen to see details of products designed with sustainability in mind so that they can apply these lessons to their own design work.

When examining student feedback on both the product lifecycle and global footprint posters, students often asked for further clarification of the issue in question and felt they needed much more detail in order to understand the concept fully. This may be inappropriate for a poster as detailed text could be difficult to read and detract from the images being used. In contrast other comments suggested that they would prefer a poster with an introduction, showing more drawings, with simple language explaining each step or process, concluding with a summary of what the poster has said. The students suggested that the poster should be eye catching and lively, but at the same time not too cluttered or complicated to follow. This suggestion highlights the issue that alternative ways of communicating these messages, possibly considering different learning styles, should be found to impart all the information the students require without causing a poster to appear cluttered.

The poster series was designed to support the website and handbook provided by the SDA, which allowed the posters to be developed in simple uncluttered formats with reference to the additional materials when more detail was required. However the SDA materials do not cover the sketching and layout information that was a preferred element of the poster designs, hence more poster space dedicated to these.

Poster Design Ideas

The students' produced 'brainstormed' poster ideas during the SDA weekend. A number of ideas emerged showing their perception of what sustainability was and how the concept affected them. It was interesting to note that the students tended to ask questions and propose explanatory scenarios to outline these initial thoughts. The main areas covered were

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posters depicting the impact of using products i.e. how much damage we do, and posters which suggested ways of reducing, reusing and recycling.

Table 1 illustrates the main ideas from the student 'brainstorm' of potential posters which have been grouped under the three original poster headings:

Product Concepts	Life Cycle	Global Footprint
Illustrating innovation and creative thinking	Reduce, re-use, recycle	Typical user image
Sustainable design checklist	Recycle after use	Idea of progression – future impact
Go 'Green' – traffic lights analogy	Sustainability – how, where, why, what.	Product examples <ul style="list-style-type: none"> • CDs • Oranges • Kettles “think before you drink”
Applying design tools <ul style="list-style-type: none"> • Eco Indicator • Design Abacus 	Packaging disposal	Importance of the user to sustainability

Table 1 Student poster ideas

As well as these poster ideas there were a number of scenarios suggested that students felt could have been included, these were:

- What if there was no room? – Would we have to live on Mars?
- What if there was no water?
- Humans Vs Earth
- What we manufacture today may affect the world tomorrow
- Consider future generations
- How sustainable are you?

The students' also sought further information about sustainability and sustainable design. The issues of; global impact, what can be achieved by implementing sustainable design ideals, how materials and components are recycled and what happens to materials and components which are not were considered important. Through analysing the students' responses it is clear that they like to relate issues of sustainability to themselves.

Consequently real life examples are preferred, such as; how they can reduce what they consume, how they affect the earth and examples of new ideas or developments in recycling.

Further Poster Development

The next stage was to produce more posters with the design and content informed by the findings from the previous survey. This task was undertaken by an undergraduate design student from Loughborough University's Industrial Design and Technology programme, who was working for ITDG during a sandwich year placement. The undergraduate student's experience and outlook offered a significantly different perspective to the industrial designers', potentially enriching the poster generation process.

In the initial survey students stated that they would like a poster that they could directly relate to and therefore one was created that

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outlined the sustainability issues associated with jeans. The aim of this poster was to make the students think about the products and clothing that they buy and how these items are manufactured. The example of a pair of jeans was used as it was thought to be highly likely that all students own at least one pair of jeans. The comparison of the environmental performance of two pairs of jeans was represented by the use of 'Green Jeans' and 'Mean Jeans' with corresponding product attribute lists. These relative lists were created so the students could make comparisons on how each pair of jeans were created and transported to the shops and how each action affected the jeans' global impact.

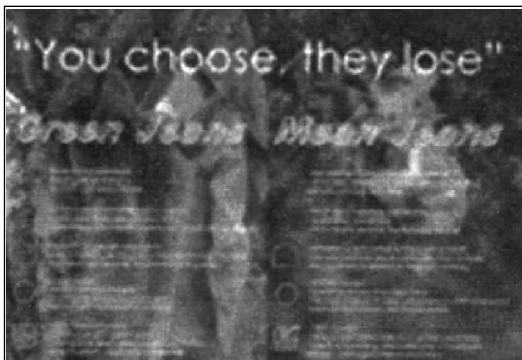


Fig. 5 Green jeans/mean jeans poster

The next poster was created with the intention of making students consider how products are designed and in turn how design decisions affect environmental impact. Students are accustomed to seeing products such as mobile phones being promoted that have been designed with little, if any, environmental considerations. In this respect they are familiar with items that have been manufactured in a certain way, by a certain process and from a particular material. They will therefore accept these options more readily rather than contemplate more environmentally sound alternatives (Badni & Coles 2003).

To improve their awareness of how product design affects environmental impact the poster

raised questions in three key areas, the social and cultural issues, the economic issues and the related environmental issues in manufacture and transport. Questions were asked under each heading to promote thoughts and discussions, including how the profits are used and how the environmental impact could be improved.

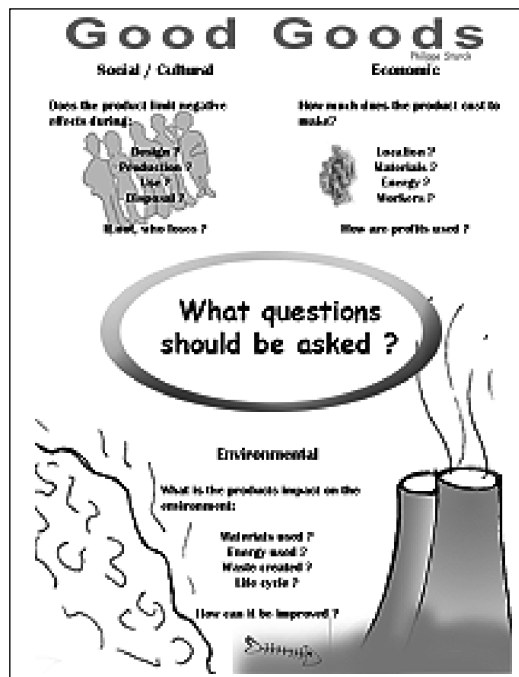


Fig. 6 Good goods poster

The third poster in this series again used a yoghurt pot as a real life example of an item that students could relate to. In line with the students' wishes, simple language and accompanying drawings were used to guide the students through the manufacture and delivery of the yoghurt and the pot. This ran in a sequential pattern with the yoghurt's development on the left hand side of the poster and the pot's on the right. The aim of the poster was to help students recognise that every product (no matter how simple) has an environmental impact.

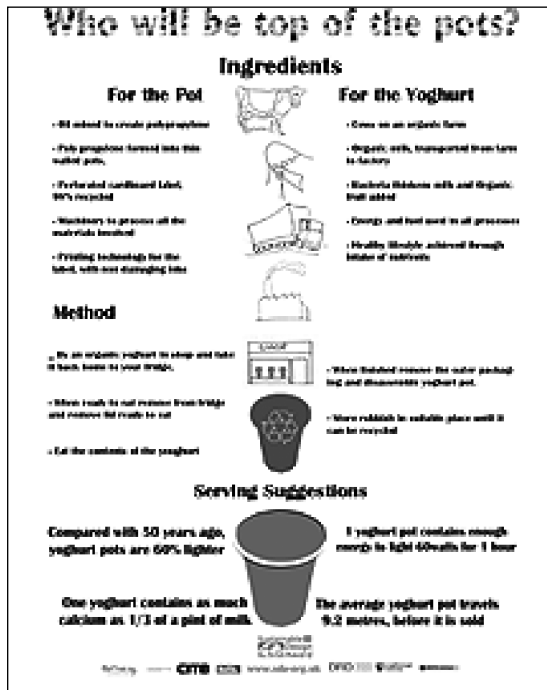


Fig. 7 Who will be top of the pots? poster

These three new posters and the original three were then presented to 24 teachers to gain their views on the usefulness of this approach, the style and content of the posters and to discover further details of what they considered useful from a poster set.

Survey of Teachers

This survey sought to elicit teachers' experiences and perceptions of posters, particularly when used as a teaching aid. It was found that half of the teachers had used posters at some level in their teaching and the majority considered that posters could be useful in supporting student's work. It was found that posters were used in different ways depending on the aim of the particular lesson. They could highlight and reinforce specific points, but usually did not have sufficient content to base an entire lesson around.

Inspiration, reference and research respectively were mentioned as areas where posters offered help. Along with presenting sustainability issues and tools, it was also suggested that posters could aid students through providing exemplars of design, layout or sketching techniques.

The teachers were presented with a list of possible poster content and asked to indicate their preference (Figure 8). Analysis showed that two different posters were required: one showing a large image of a 'real life' example of sustainable design, with minimal text; and another with many smaller images explained in more detail.

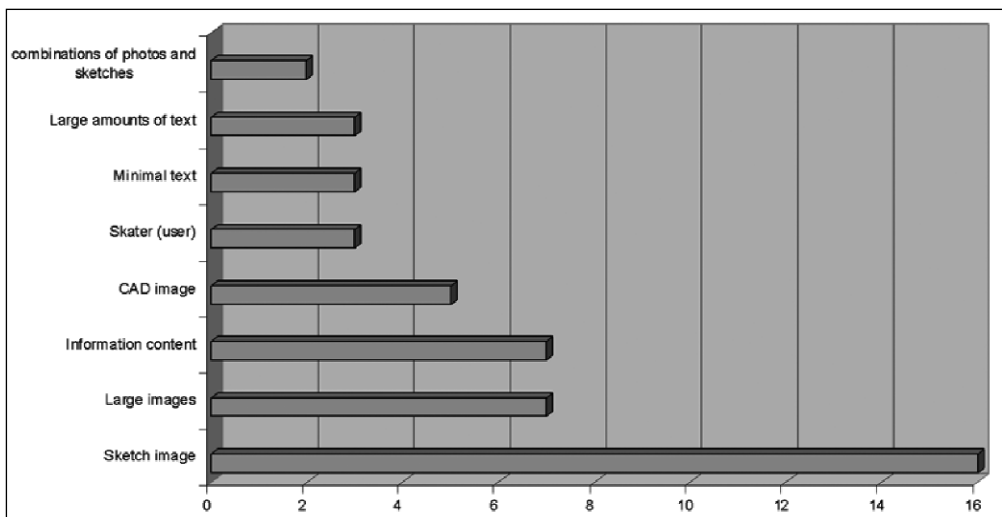


Fig. 8 Teacher preferences for poster content

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Teachers were asked to comment on the preferred lifespan of the posters. They thought that lifespan was very dependent on the content. It was recognised that some images may date quickly, or feature products that may become unfashionable. However posters illustrating sustainable design tools would have a much longer lifespan. The teachers felt that a series of posters would be beneficial to allow frequent replacement to enable them to fit in with different projects and lesson foci. Overall the posters were said to remain useful as long as the content was still relevant to the taught subject. With the intention of making the posters more memorable to the students a 'play on words' was considered for the poster title. The respondents considered that, if done well this could aid recall.

Final Poster Assessment

A final survey presented the original six posters along with five new designs to 24 teachers and 56 students spread across a number of schools, who were about to participate in the Sustainable Design Award scheme. The eleven posters were also taken to the second Sustainable Design Award study weekend held at Loughborough University in September 2004 where a further survey was undertaken involving 60 students. The five new posters aimed to address some of the outstanding issues from the previous two surveys, by exploring different graphical ways of presenting the preferred content and through presenting different content in the suggested preferred styles. Sustainability issues relating to the design and technology AS & A2 syllabus and the SDA scheme were introduced to students and teachers by the researcher. The posters and their role in supporting sustainable design were presented. Semi-structured discussions followed on the merits of the poster designs. The students were free to critically review the posters, and fill in a questionnaire. The questionnaire allowed further opportunity for comment.

The content of the new posters illustrated the three main points gathered from the initial survey result of; inspiration, information and

provocation (See figures 9-13 below). The inspiration point was illustrated by choosing an example of an existing product with sustainability credentials and comparing that with one where sustainability was not considered in its design. Figure 9 illustrates a product comparison poster which uses large product images and illustrates the two products in a sustainability context. It aimed to inspire the students by showing what could be achieved through sustainable design.



Fig. 9 Product comparison



Fig. 10 Global impact

Information was conveyed in a number of ways, firstly as illustrated in Figure 10 a well-known product (in this case a pair of jeans) is presented and the poster describes the global environmental impact of the manufacturing processes involved. The poster shown in Figure 11 presents a guide to using some of the ecodesign tools introduced to students as part of the SDA, it also illustrates how to interpret the results and implement changes in design.

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Finally, Figure 12 aimed to help students make informed choices when selecting power sources for electrical products. It illustrates two different radios and shows a comparison of the amount of power supplied by batteries and user generated power.

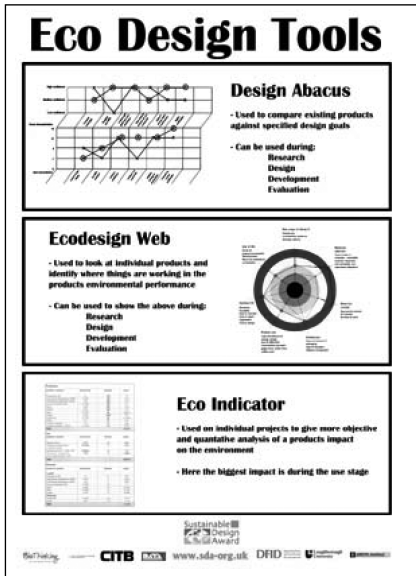


Fig. 11 Ecodesign tools

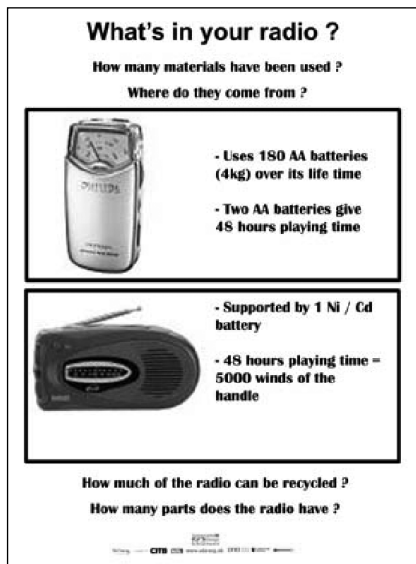


Fig. 12 Radios with different power sources

Provocation was promoted throughout the poster set by asking the question 'what can be achieved?' either directly or by suggestion. Figure 13 shows the final poster which presents a graphical articulation of a quotation from Edwin Datschefski (2001) which aims to provoke the students into considering how they can make a difference to sustainability through their designing.



Fig. 13 Datschefski quotation regarding sustainable products

Overall 87% of teachers questioned said that posters could offer them and students in design and technology support. Seventy percent of students surveyed suggested that posters could offer a constant reminder of what needed consideration and what could be achieved in the course of a design project. Students considered posters to be more accessible than books and more readily available than websites when designing. However, it was generally agreed that the value of these posters was heavily dependant on the content and clarity of the presentation. The posters presented provided a range of information and inspiration, however there was an apparent need for posters and teaching support materials covering all aspects of the design and technology curriculum including an exemplar product for each case.

The main area of interest lay in real life examples of more sustainable products across the five areas of the design and technology curriculum being Textiles, Food, Systems and Control, Resistant Materials, and Graphics.

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Dramatic and inspirational product images were considered necessary to attract the students to the posters; however it was felt that this should be supplemented with contextual information, explaining the significance of the image and how sustainability issues or exemplar design process details can be applied to coursework. This supplemental information was required to increase the efficacy of the posters and is provided as part of the Sustainable Design Award Student Website.

The students stated a desire for large colourful images with small amounts of text. The teachers had similar ideas but suggested two directions for poster development which reflected the previous teacher survey, a large exemplar image with minimal text, and secondly many small images with a more detailed description.

The students suggested that hand drawn images 'draw you in' and generate interest in the poster. Hand drawn images are something that the students can relate directly to their own design work. A series of supporting sketches for a finished sustainable product design could be used to illustrate both designing and sustainability issues. Exploded views, showing product construction and assembly/ disassembly, with materials and components labelled with cutaway sectional views were also requested by the students.

Conclusions

From the students' poster design ideas it was apparent that even though the Global Footprint poster was the least favoured it encapsulated the majority of the sustainability concepts remembered by the students. On the whole students liked the toaster poster, containing sketches with annotations, with a sequential type layout. This may be due to the lack of 'sketch' style posters available to students, as most professionally produced posters only use sketching at their initial design stage. The students may also have liked the sketching as it gave them an example of how professionals undertake design projects, which they could then relate back to the Sustainable Design

Award and their design and technology coursework. Hence the sketch presentation style used in the toaster poster may be suitable for applying to the Global Footprint poster amongst others.

Other comments have suggested that students may prefer posters with an introduction, showing: more drawings, with simple language explaining each step or process and concluding with a summary of the key issues raised. The students have suggested that the poster should be eye catching and lively, but at the same time not too cluttered or complicated to follow.

The positive responses to the early iterations of the posters showed that some elements presented were required in the final versions. However, the aim, how the poster fits into each subject area and the overall context of design and technology, should be made more apparent. The level of detailed information contained on a poster is limited due to the available space, but the idea of using posters was welcomed as long as posters are supplemented with additional resources (as is the case with the Sustainable Design Award). The posters can then provide highlights or snapshots of the bigger picture of sustainability and sustainable design.

It is interesting to note that the results of this research with young student designers reflects previous work undertaken by Lofthouse (2001) with professional designers which identified the style and content requirements for communication of sustainable design. Lofthouse (2001) concluded that designers required both information and inspiration, presented in a simple, easily accessible format to enable them to begin to engage in and undertake sustainable design.

One question arising from the research concerns the learning styles favoured by the students. The authors hypothesise that the preference for images and minimal text on the posters could possibly be due to a prevalence of visual learners undertaking design and technology subjects, yet do not have sufficient

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evidence at this stage to fully support this theory. Storer & McDonagh (2005) proposed that designers and design students responded more readily to visual stimuli than written. Hence further research to establish learning style preferences in a significant sample may be worthwhile. The posters featuring methods and tools for sustainable design tend to feature more text to explain the process of applying the tool. Consequently these types of posters may not appeal to the more visually oriented users and this could be the reason why these were not favoured by students or teachers.

Overall, it can be concluded that posters provide a useful and innovative method of communicating sustainable design, a relatively new and complex subject, to students within the design and technology context. However, care should be taken to ensure the style applied is one that appeals and also that additional more detailed information is easily available. It is hoped that the initial enthusiasm created by the posters can be built upon and students can then directly apply the learning on the subject to their design work.

These findings are now being used to produce a final poster set which will be trialled, refined and then published by ITDG in the coming year and available for use in schools.

Details about Sustainable Design Award

Any schools wishing to register their interest in the Sustainable Design Award should contact Ian Capewell, ITDG, Schumacher Centre for Technology & Development, Bourton Hall, Bourton on Dunsmore, Rugby, CV23 9QZ. T: 01926 63440, E: education@itdg.org.uk. For Further information see <http://www.sda-uk.org.uk>

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